Effect of a clean stove intervention on inflammatory biomarkers in pregnant women in Ibadan, Nigeria: a randomised controlled study

Elizabeth Frank, E Bartlett, D Alexander, A Dutta, D Adu, T Ibigbami, F Edem, G Arinola, T Karrison, CO Olopade

Published Online
April 8, 2016

Center for Global Health, University of Chicago, IL, USA (E Frank, D Alexander PhD, A Dutta PhD, E Bartlett MS, C Olopade, MD.)**; Healthy Life for All Foundation, Ibadan, Nigeria** (D Adu MPH, T Ibigbami MPH)**; College of Medicine, University of Ibadan, Ibadan, Nigeria** (F Edem BSc, G Arinola PhD)**; Department of Public Health Science, University of Chicago, Chigago, IL, USA** (T Karrison PhD)

Correspondence to Christopher Olopade, MD, Center for Global Health, 5841 S Maryland Avenue, MC 6076, University of Chicago, Chicago, IL 60637, USA.
solopade@bsd.uchicago.edu

Abstract

Background 3 billion people cook, heat, and light their homes using polluting fuels such as biomass and kerosene. Household air pollution is a known risk factor for acute lower respiratory tract infections and non-communicable diseases including stroke, chronic obstructive pulmonary disease, and lung cancer. Exposure to household air pollution has been linked to increased presence of systemic inflammatory biomarkers. Here we aimed to assess whether a change from a traditional wood or kerosene biomass stove to use of a bioethanol-burning stove could reduce the presence of inflammatory biomarkers in pregnant women in Nigeria.

Methods Between 2013 and 2015, we recruited pregnant women in Ibadan, Nigeria during their first trimester of pregnancy. Patients were excluded if they cooked for a living, smoked or had a smoker in the household, or had a high-risk pregnancy (age greater than 35 years, multiple gestation, diabetes, HIV infection, previous Caesarean section, or more than three miscarriages). Participants were randomly allocated to either a control group or the intervention group using permuted blocks and the web-based randomisation module available in REDCap. Control participants continued to use their own stove, which was either biomass (ie, firewood) or kerosene, while the intervention group received a bioethanol-burning CleanCook stove. We used ELISA to measure serum concentrations of retinol-binding protein (RBP), malondialdehyde (MDA), TNF-α, IL-6, and IL-8. Our primary outcome was the change in concentrations of these inflammatory biomarkers between baseline and the third trimester. The trial is registered in ClinTrials.gov (NCT02394574).

Findings Between July, 2013, and March, 2015, we enrolled 324 pregnant women (162 to each study group); 18 women were lost to follow up before delivery. Measurements of biomarkers made more than 60 days before randomisation (17 participants) or more than 300 days after randomisation (26 participants) were excluded from amalysis, as were data for 17 other women because of inconsistent dates. Thus data from 246 women were included in analysis. Mean (SD) change in RBP, MDA, TNF-α, IL-6, and IL-8 between baseline and the third trimester was –2·16 (4·47), –19·6 (46·4), 3·72 (37·2), 0·51 (14·4), and 13·2 (197), respectively, in the intervention group and –2·25 (4·30), –24·6 (43·6), 7·17 (32·6), –1·79, (11·4), and 31·3 (296) in the control group. None of the mean changes differed significantly between the two study groups. However, changes from baseline in TNF-α levels were significantly different between the intervention and control groups in the subset of women (n=99) who were using firewood before the trial (–7·03 [32·9] *vs* +12·4 [33·6]; 95% CI for group difference: –35·4 to –3·4, p=0·018). Third trimester concentrations of MDA were also significantly lower in initial firewood users allocated to the CleanCook group compared with those in the control group who continued to use firewood (ANCOVA p=0·030). There were no significant favourable differences in the interval change of biomarkers in women who initially used kerosene stoves. Women in the control group were offered CleanCook stoves at the end of the trial.

Interpretation The decrease in serum concentrations of TNF-α from the first to third trimesters in women who used the CleanCook stove could indicate the reduction of cardiovascular stress and prothrombotic effects from decreased amounts of household air pollution. Furthermore, our findings suggest that the replacement of wood-burning biomass stoves with ethanol-burning stoves might decrease concentrations of inflammatory markers and, therefore, mitigate cardiovascular and pulmonary disease in pregnant women.

Funding Global Alliance for Clean Cookstoves through United Nations Foundation.

Declaration of interests
We declare no competing interests.